Function Features and Intervals

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Tues Oct 14

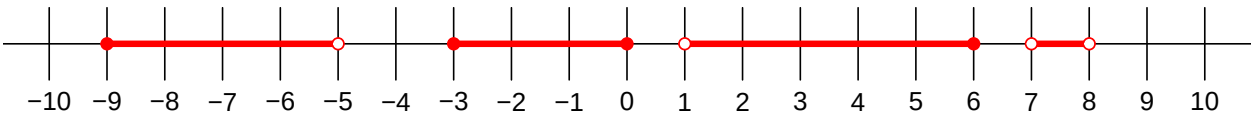
Function Features

- **Domain**
- **Range**
- **Increasing/decreasing**
- **Positive/negative**
- Extrema (local and global minimums and maximums)
  - We will cover these another day
- Intercepts (with x axis or y axis)
  - These you already know, and we will cover these another day.

Interval notation

- Standard interval notation looks kind of like the notation we use for Cartesian coordinates.
- Parentheses indicate an exclusive boundary.
- Brackets indicate an inclusive boundary.
- A union symbol ($\cup$) indicates a union of multiple intervals.
- Examples:
  - $(3, 5)$ means all real numbers between 3 and 5, but NOT including the boundaries. As an inequality, $3 < x < 5$.
  - $(3, 5]$ means all real numbers between 3 and 5, but NOT including 3. As an inequality, $3 < x \leq 5$.
  - $[3, 5)$ means all real numbers between 3 and 5, but NOT including 5. As an inequality, $3 \leq x < 5$.
  - $[3, 5]$ means all real numbers between 3 and 5, including both boundaries. As an inequality, $3 \leq x \leq 5$.

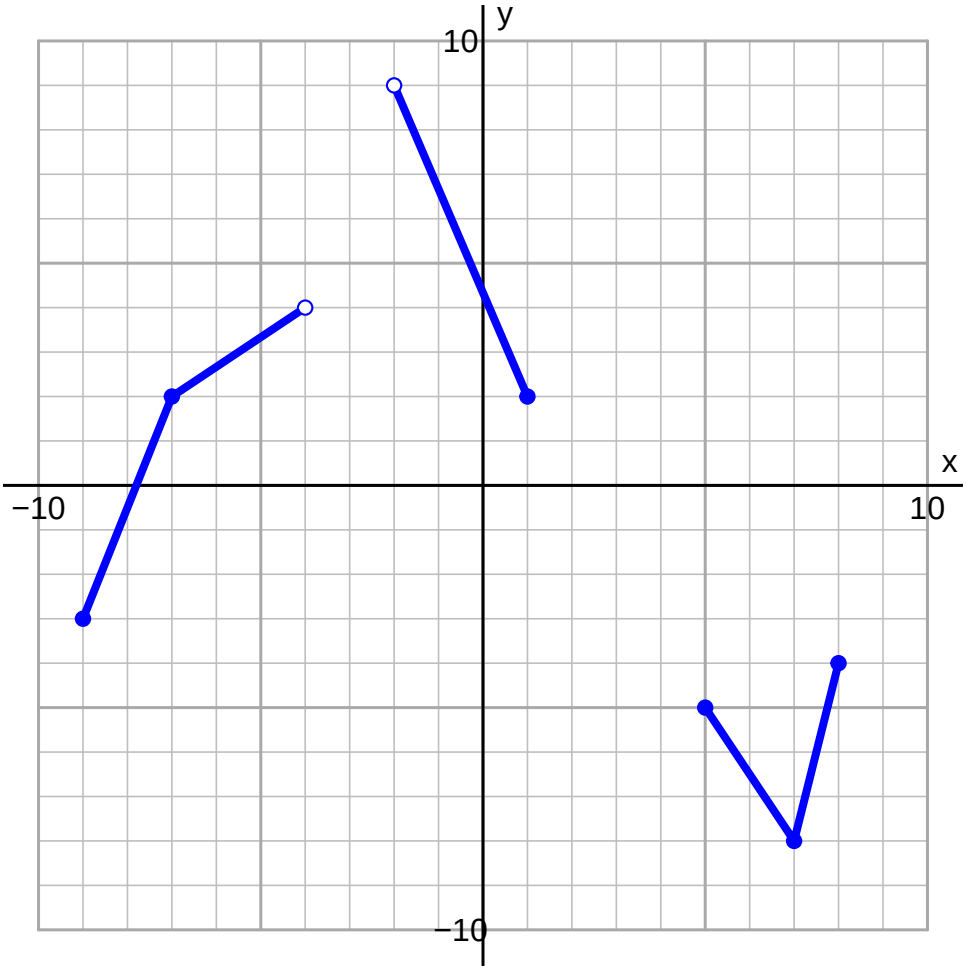
Using interval notation, express the real numbers highlighted on the number line below.



- $[-9, -5) \cup [-3, 0] \cup (1, 6] \cup (7, 8)$

Domain of a function

- The domain of a function describes the set of possible inputs (the possible x values).
- Using interval notation, express the domain of the function shown below.



- Imagine the function flattening onto the x axis.
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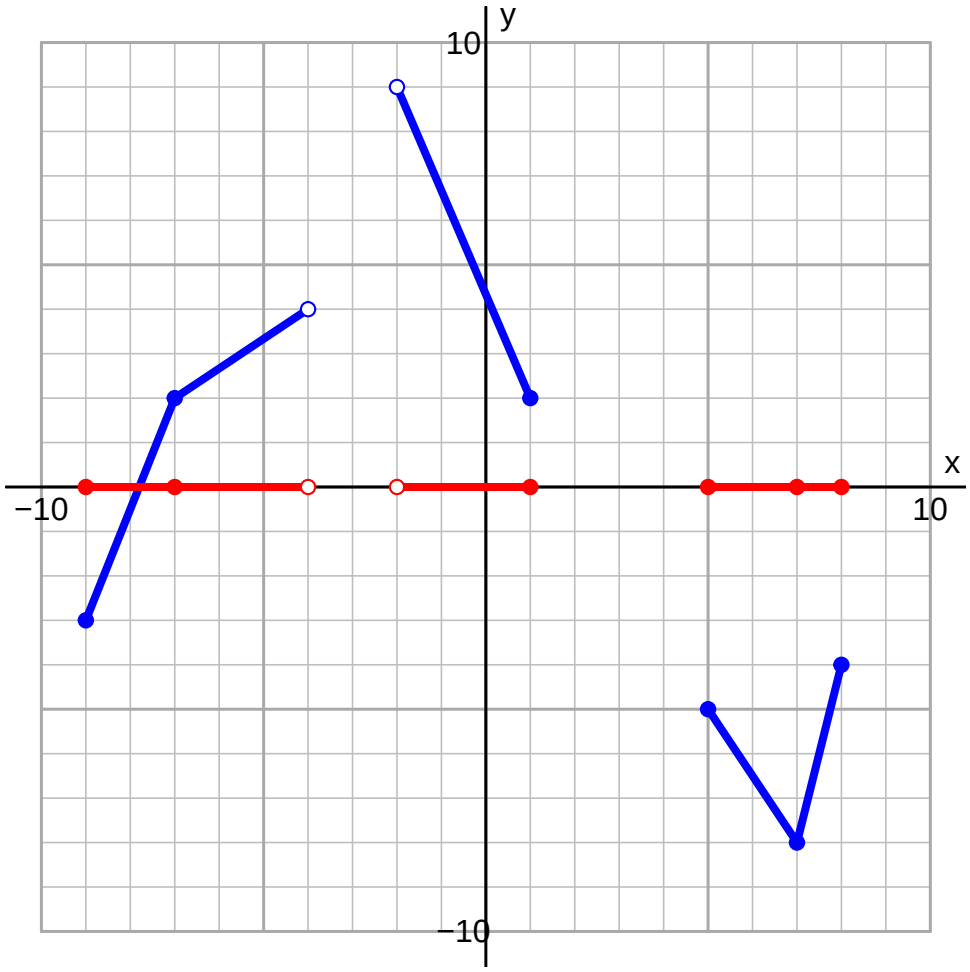
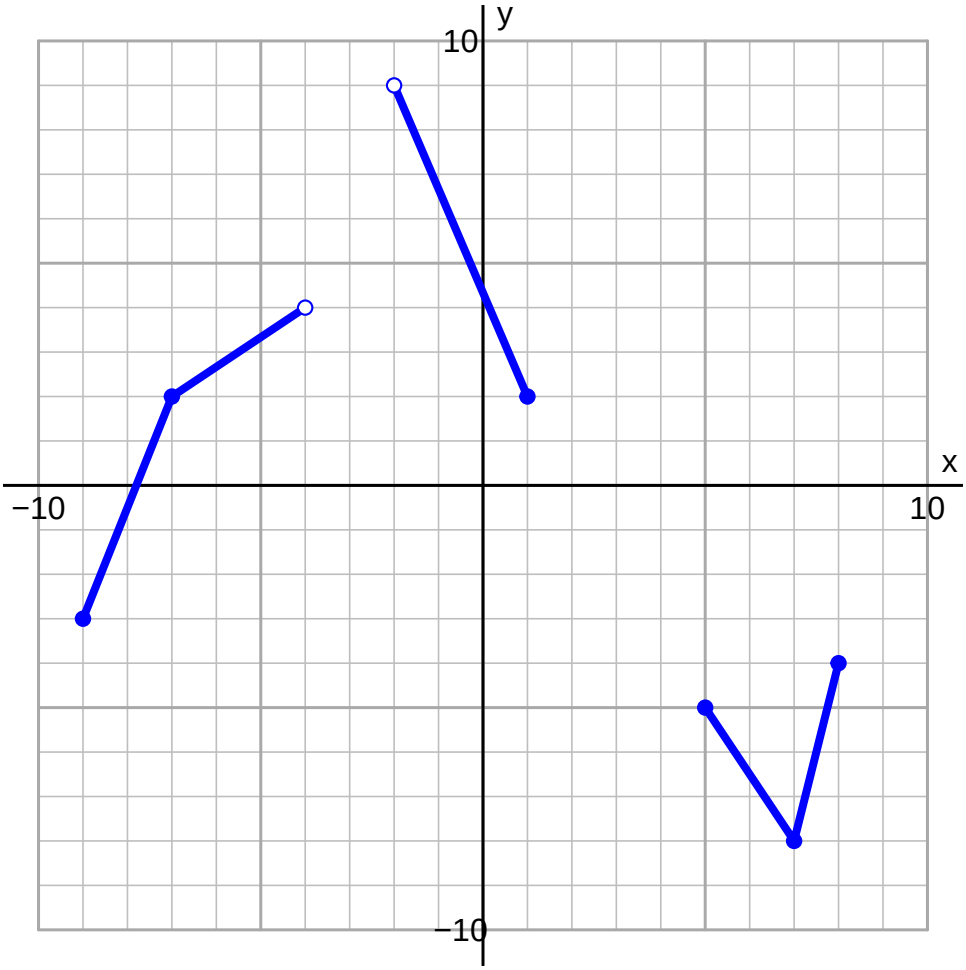


- Domain:

$$[-9,-4) \cup (-2,1) \cup [5,8]$$

Range of a function

- The range of a function describes the set of possible outputs (the possible y values).
- Using interval notation, express the range of the function shown below.



- Imagine the function flattening onto the y axis.
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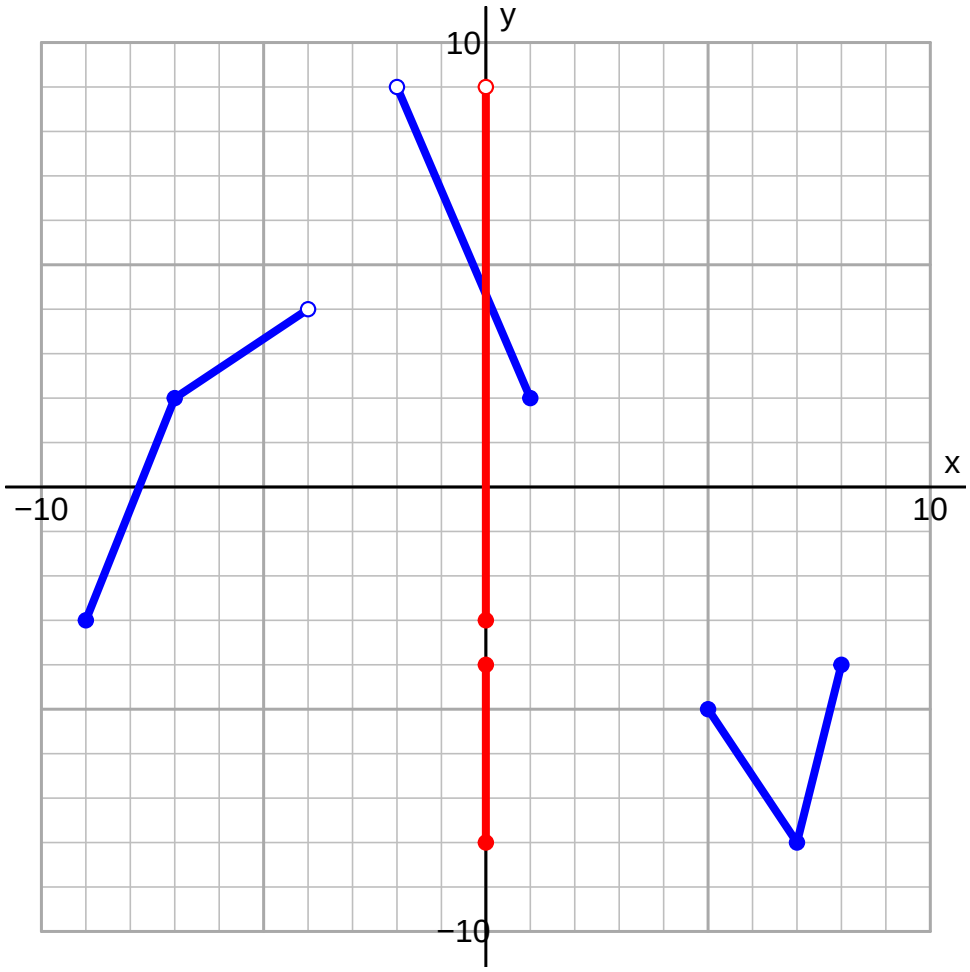
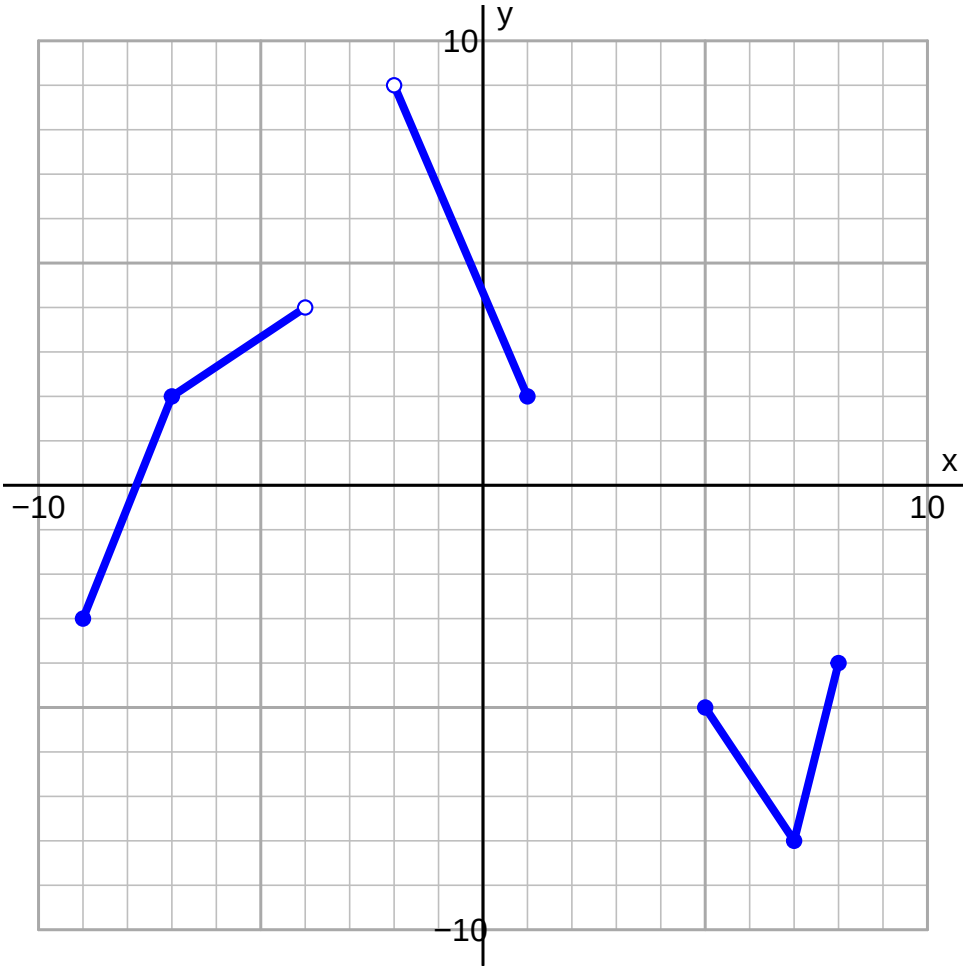


- Range:

$$[-8, -4] \cup [-3, 9)$$

Where is function INCREASING?

- Follow curve left to right (like when reading English).
- I imagine an ant hiking left to right along the mountain ridges.
- If curve is going up, it is increasing.



- Using function notation, express where the function is increasing.
- Notice, on functions, we indicate "where" with the x values.
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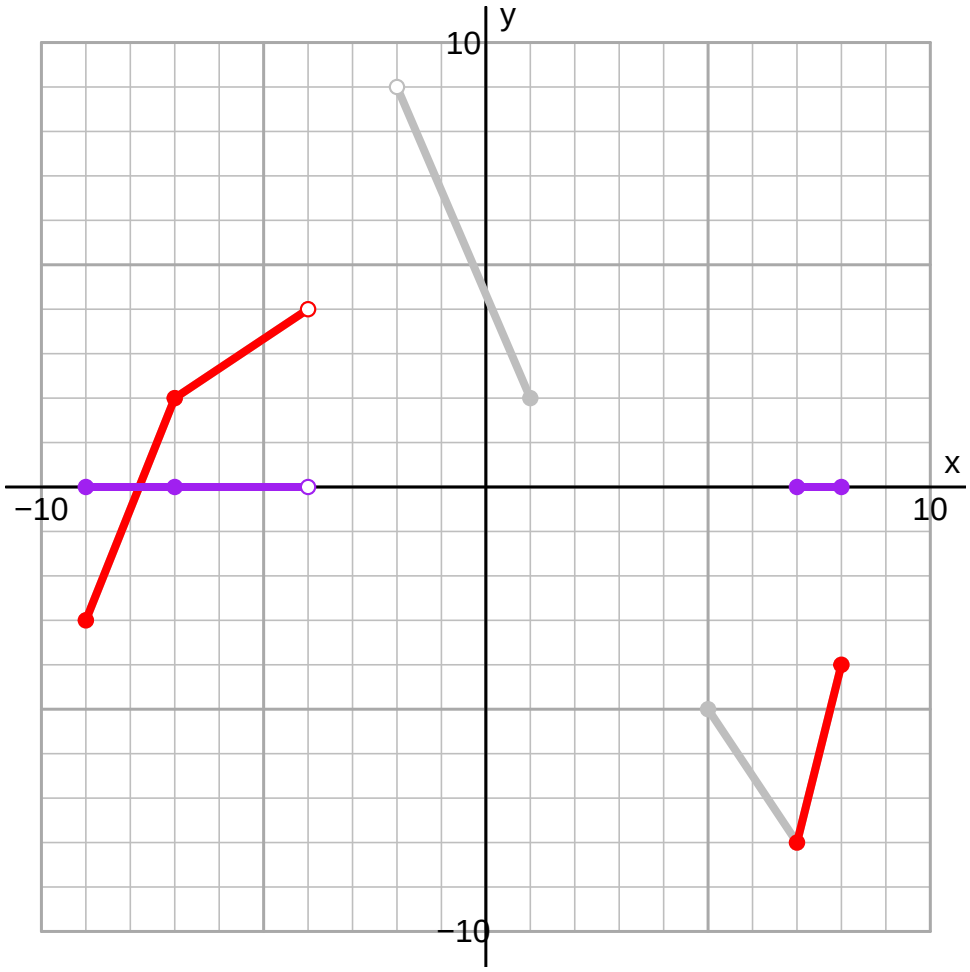
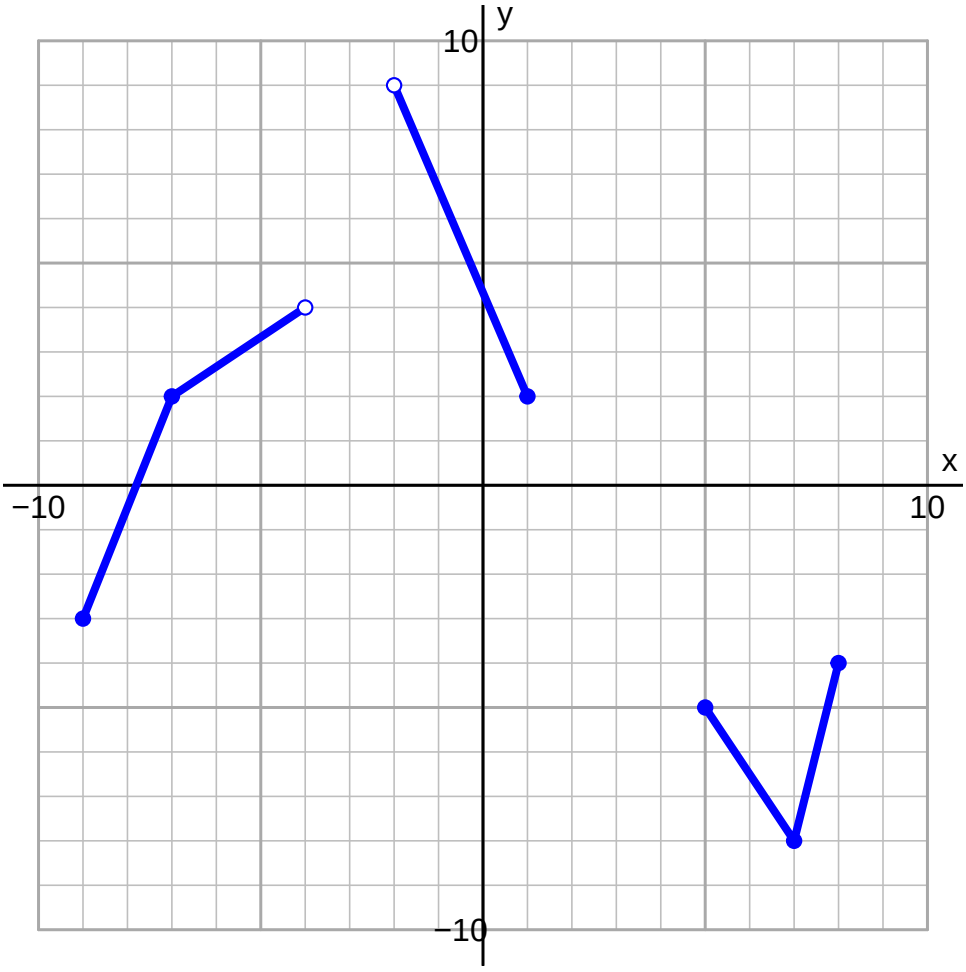


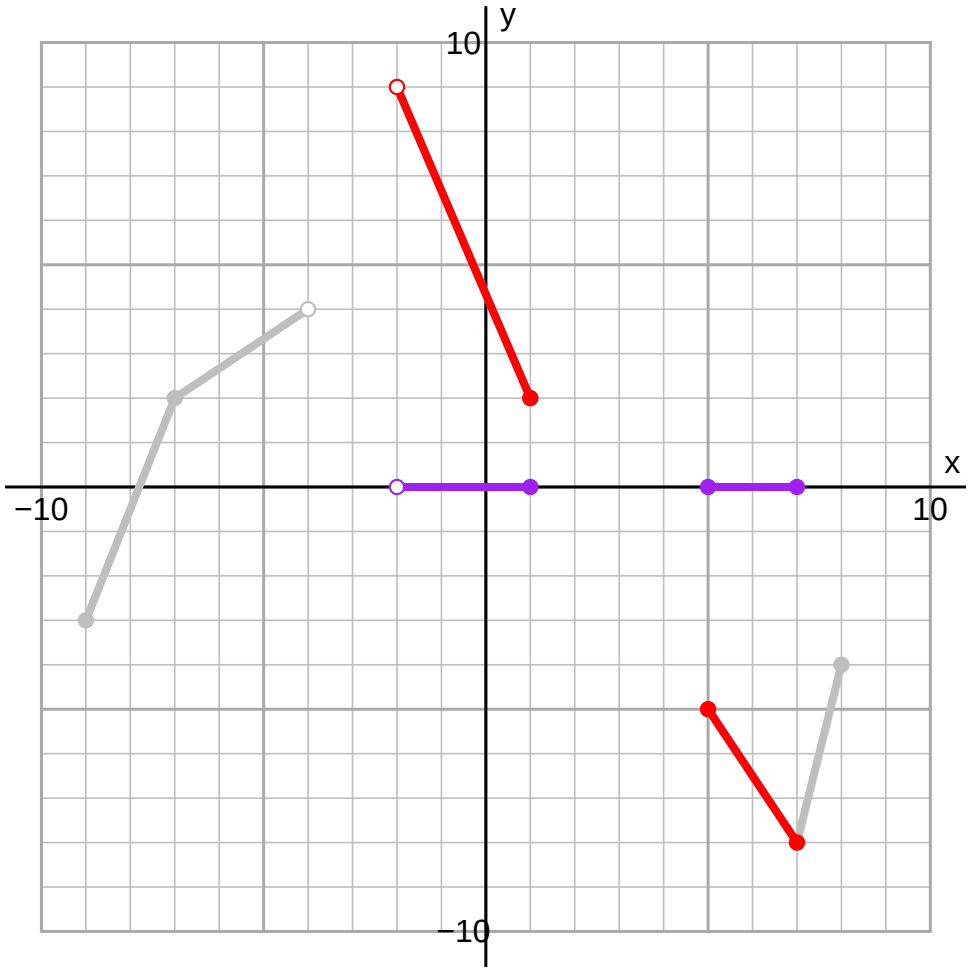
- $$[-9, -4) \cup [7, 8]$$
- Although, if we want to get into a debate, I'd personally argue it is better to not include endpoints in intervals of increase/decrease. You can read a thorough treatment of this discussion here: https://www.themathdoctors.org/open-or-closed-intervals-it-depends/
- In other words, I'd also accept
$$(-9, -4) \cup (7, 8)$$

Where is function DECREASING?

- Follow curve left to right (like when reading English).
- I imagine an ant hiking left to right along the mountain ridges.
- If curve is going down, it is decreasing.



- Using function notation, express where the function is increasing.
- Notice, on functions, we indicate "where" with the x values.
  -

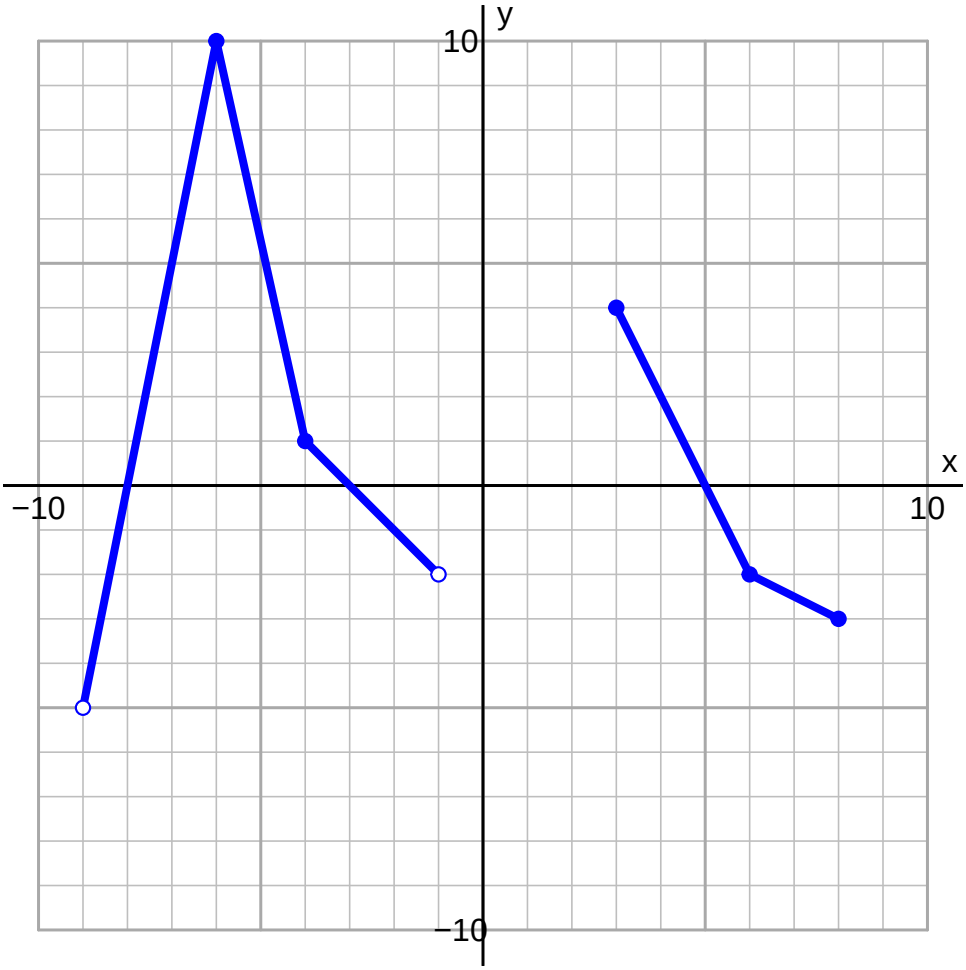


- $$(-2, 1] \cup [5, 7]$$
- Again, we can argue that the boundaries should not be included. So, I'd also accept

$$(-2, 1) \cup (5, 7)$$

Where is function POSITIVE?

- A function is positive where it is above the x axis.



- Using function notation, express where the function is positive.
- (Remember, we are indicating x values to denote "where" on a function.)
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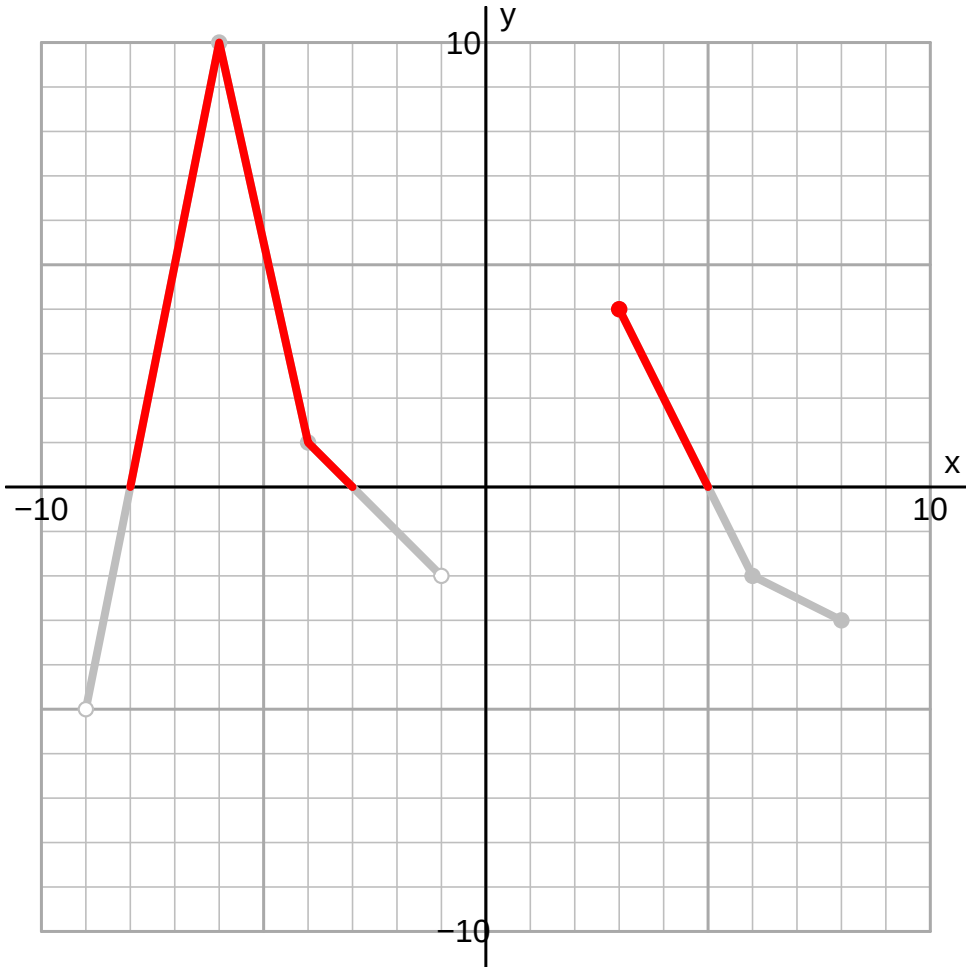


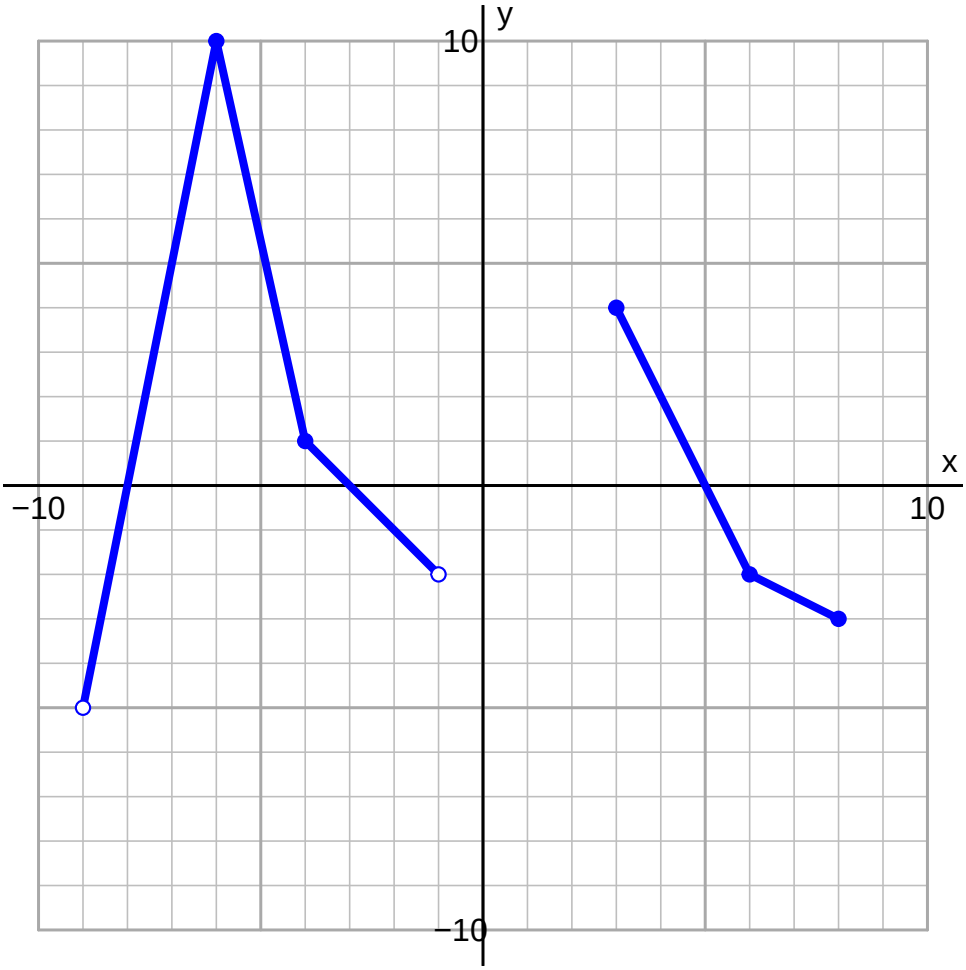
- The function is positive when x is within the intervals indicated below:

$$(-8, -3) \cup [3, 5)$$

- Notice I am not including the x intercepts, because 0 is not positive.

Where is function NEGATIVE?

- A function is negative where it is below the x axis.



- Using function notation, express where the function is negative.
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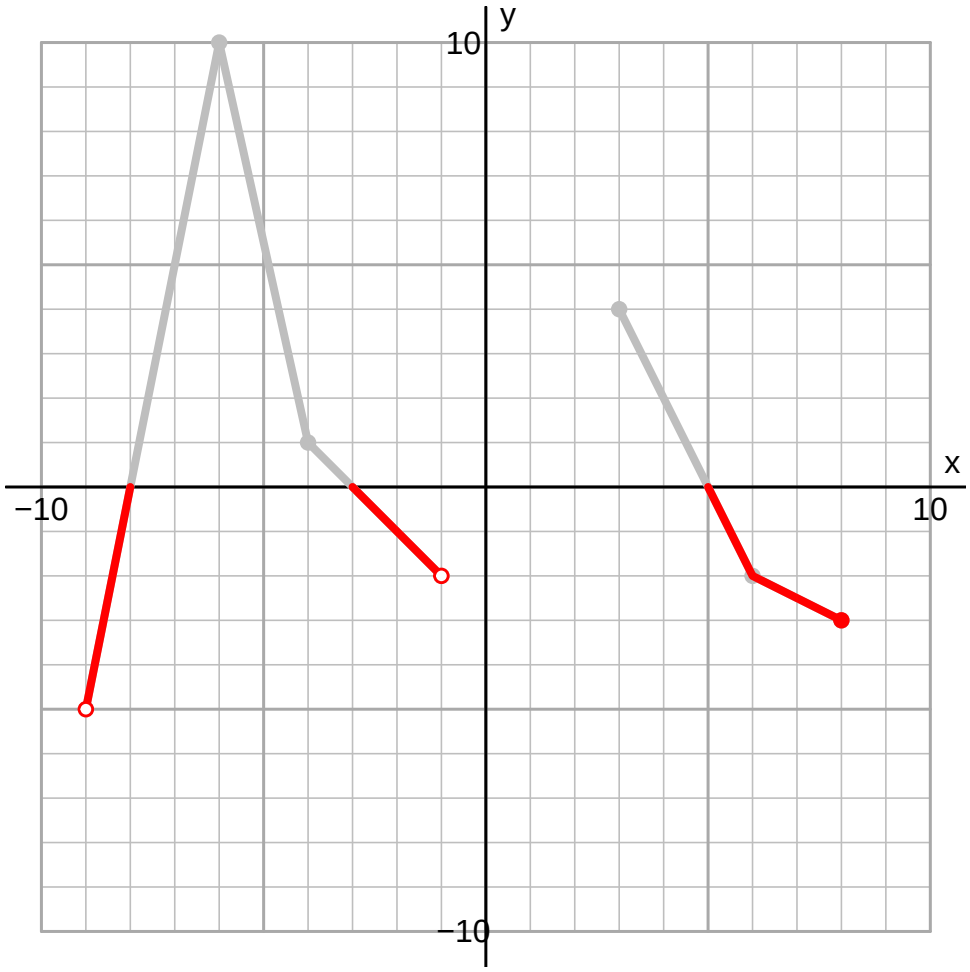

- The function is negative when x is contained in the set of real numbers expressed below in interval notation:

$$(-9, -8) \cup (-3, -1) \cup (5, 8]$$

- Notice I am not including the x intercepts, because 0 is not negative.